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Section I

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EDITORIAL DEPARTMENT NOTE

With fixed or long-life assets representing approximately one-half the total assets of the average industrial concern the subject of accounting for such assets is a matter of primary importance to every accountant. Much has been written on bases of valuation, methods of depreciation, treatment of repairs and replacements and related subjects, resulting in a great mass of published information containing many conflicting opinions and diverse views. It is felt that the article in this issue of the Bulletin will be helpful to our members in clarifying their thinking regarding accounting for fixed assets and in developing a unified body of principles with respect to this field of accounting. In the words of the Publication Director who forwarded the manuscript to Headquarters, "it constitutes a valuable addition to available accounting literature on a subject regarding which much muddy thinking exists."

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LONG-LIFE ASSETS

WHEN TO BUY AND HOW TO ACCOUNT FOR THEM

By E. S. Freeman, Budget Controller
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Definitions

EVERY dollar spent for a business purpose is both (1) a cost incurred for the purpose of securing revenue in excess of such cost, i.e., to secure a profit, and (2) an investment until such revenue is secured or the expectation of it abandoned. While invested it ties up capital and is therefore capitalized. The property in which it is invested is called an asset. Money invested in materials, labor, rent, and merchandise can usually be recovered in a year or two. On the other hand, money invested in tools, automobiles, furniture, machinery, ships, and buildings may take from 5 to 50 years for its recovery. The former are classed as short-life or current assets and the latter as long-life or (relatively) fixed assets. The one real difference between them is in the length of time required for a realization of profit and the difficulties of foresight which time introduces.

When to Buy

Selection of Investments

The only business reason for spending money is to increase profits over and above what they otherwise would be. The only business reason for spending it for one purpose instead of another is because the purpose chosen offers a greater opportunity for profit.

Every concern should develop a policy in respect to replacements and expansion. It should make a systematic study of the efficiency of its equipment and attempt to forecast the probable range of its sales and cash requirements for at least several years ahead. Instead of spending money for whatever is thought of first, it should lay out a long-range program and select its investments according to merit.

A good procedure is to list all proposed investments (or classes of investments) showing the following estimates for each:

(1) The cost of investment proposed; i.e., of long-life asset and its installation and of any other initial expense in connection with proposal (e.g., moving) which has not been deducted from the value of the expected benefit. If there is any salvage or turn-in price for any asset supplanted, the cost of the investment would be reduced by the amount to be so received or credited.

(2) The average value per year of expected benefit, i.e., either an increase of revenue or a reduction of cost or contingent loss of revenue. If some of the values, costs, or risks are so intangible that they cannot be expressed in figures they should be explained in footnotes.

(3) The number of years benefit is expected to continue, figured conservatively, but not so conservatively as to interfere with progress.

(4) The annual contribution which the average value of the expected benefit must pay toward the cost in order to have the cost all paid for (except for its salvage or turn-in value) by the time the life has elapsed.

(5) The net profit per year from proposed investment, i.e., the excess of the value over the required contribution.

(6) The average investment during period. This would be one-half of the sum of the investment at the beginning and at the end (salvage or turn-in value). If the value at the end is negligible this will be approximately one-half of the cost of the investment.

(7) The percentage of profit on average investment, i.e., percentage that (5) is of (6).

The proposed investments can then be arranged on the list according to the percentage of expected profit with the highest percentages at the top and the lowest at the bottom. If any intangible values, costs, or risks have not been considered, the manager can change the priorities of the items affected. The available capital can then be assigned to the items on the list starting at the top and working down as far as the available capital will permit, but not lower than the percentages justify its use.

The rate of profit which should be earned on the average is a rate which will at least sustain the long-range trend of the market

price of the company's shares. The earnings and market price per share should each be plotted over a series of years and a normal or desired average percentage of profit to the stockholders investment computed. This can be used as a guide to the percentage of profit which should be obtained on the average. If investments with a lower rate are selected without a corresponding amount at a higher rate, the market value of the shares will in time tend to be depressed.

If the risk is higher or lower than average, the rate of profit might be expected to vary accordingly. The risk is likely to be greater for long-life than for short-life assets. While peak loads of the latter can be financed by bank loans at a low interest rate, a higher rate is desirable for long-life investments. Mortgages and bonds may carry a lower rate of return than the company's equity shares, but that is because they are cushioned by the latter, which is thereby forced to carry a greater risk than if all permanent capital were obtained from stockholders.

Reasons for Buying Equipment

The more specific reasons for buying long-life assets may be classified as follows:

(A) To increase revenues—
  (1) by expanding volume of existing products,
  (2) by improving value of existing products,
  (3) by offsetting a decline in volume or value of product due to deteriorating equipment,
  (4) by introducing additional products.

(B) To reduce costs—
  (1) by saving operating costs through substitution of more efficient equipment,
  (2) by saving cost of repairs and lost time due to repairs.

Quite often these reasons will occur in combination. In such cases the benefits from each should be added to obtain the combined benefit.

Equipment to Increase Revenues

Before buying equipment for expansion of sales one should chart past sales and the ratio of operating time to existing capacity.

This will permit a better judgment as to whether the apparent upward movement is likely to continue or be temporary. Often it is cheaper to increase production by a better distribution of the operating time or by running machines more hours per day. The increase of profit from expansion of sales must pay not only for the investment in the additional machine but also for the investment in increased inventories and receivables.

Improving the quality or delivery service, or the adaptation of products to a changing market may permit an increase or prevent a decline in price or volume. If the market factor is dominant and the investment is not large the purchase is likely to be considered imperative. In less urgent cases the expected increase of profit or reduction of loss can be compared with the investment as previously explained.

In the case of a new product involving new equipment the problem is somewhat the same as if a new business were to be launched. All of the expenditures, including the cost of the equipment, must be matched against the expected income during the life of the equipment.

Equipment to Reduce Costs

When no change in the value or volume of product is involved and the only benefit is a saving of cost the problem is primarily one of mathematics. The only difficulty is that of determining the facts.

The saving of cost must be estimated very carefully. Average cost figures designed for routine use are not good enough for this purpose. All of the expense which is included in the hour rate will not be reduced pro rata with the operating time. A comparative statement should be prepared showing an analysis of both the existing cost and the expected cost. This should show the detail of all items included in the overhead rate. Each item can then be studied to see what the savings are likely to be in fact. An expense is not saved merely by shifting the charge elsewhere. Floor space is not saved except to the extent that it can be made to earn profit in other ways.

The choice will not lie between buying the old machine and buying the new one. The old one is already owned. No depre-

ciation or interest on it will be saved by the discard except to the extent of the salvage or turn-in price. With this exception, the cost and investment in the new machine will be entirely additional at least until such time as the old machine would have had to be replaced on account of wear or other reason.

The valuation at which an old machine is carried on the books is of no help in deciding whether or not it should be replaced. Whenever the profit from replacing a machine is sufficient to justify its replacement that machine is obsolescent. If it hasn't yet been written off it will still have to be written off sometime and ought to be written off at once, whether the new machine is substituted or not.

The number of years a machine will require to pay for itself tells nothing unless one also knows how long the benefit from its use will last. A machine which will pay for itself in three years is one which shows a return of 33⅓% a year. If such saving lasts for only three years, nothing but the principal will be returned. If it lasts ten years, 10% a year will replace the principle and 23% will be left for profit. This would be 46% a year on the average investment. While a three- or five-year rule may work well in certain individual cases, neither has any scientific basis for general use.

Optimum Rate of Replacement

The more frequently machines are replaced the more rapidly they must pay for themselves. If, for example, replacements are made every six years instead of every eight, each year's savings must contribute one-sixth instead of one-eighth of the cost of the machine.

Other things being equal, the cost of machinery increases in direct proportion to the number of machines purchased. The savings from more frequent replacements increase at a less rapid rate because each successive saving applies to a shorter period of time. Hence, the percentage of profit to investment tends to decline as the intervals between replacements are shortened.

The optimum rate of replacement is one which permits all available capital to be invested at the highest rate of return.

Accounting for the Cost

Depreciation or Cost Instalments

One principal function of accounting is to ascertain the margin of profit or loss on business transactions. In order to do this the accounts must carry forward the record of money spent until such money can for comparison be charged off against the money received.

Nothing lasts forever. Science, history, and law deny perpetuities. Even if an asset is not immediately consumed or sold, its life and its utility will nevertheless be limited by the following factors:

(a) physical depreciation or deterioration due to wear and tear or action of the elements;
(b) economic depreciation or obsolescence due to decline in sale of product or the invention of better ways of doing business;
(c) possible inadequacy to meet the needs of a growing business.

Unless the cost of the long-life assets is all charged off against the revenues before the inflow of revenue from its use ceases, the profits will have been overstated, the directors and stockholders misled, and perhaps dividends may have impaired the original capital contribution.

Hence it is customary to spread the cost of a long-life asset over its period of service in annual charges usually called "depreciation." Etymologically, this word means a decline in value like the decline in the sale price of an automobile after purchase. In accounting, however, it is used to mean something more nearly the way in which we pay for the cost of an automobile on the instalment plan.

The distinction between value and cost should be kept carefully in mind if we are to think and talk clearly on this subject. Value is what something is worth as a direct or indirect source of future income. Cost on the other hand is what the owner paid for it in the past. This distinction would be clearer if the use of the word "depreciation" were confined to a decline in value and if these annual contributions toward the cost of the asset were called "cost instalments."

Value Depends Upon Earnings

Value is not to be confused with present efficiency. Rather it is the aggregate of future efficiencies. An automobile, for example, may retain a high degree of efficiency for several years, but its value in terms of future service steadily declines. Also a machine may retain full value for the purpose it was designed to serve, but if nobody wants it for that purpose its value has become extinct.

Most products go through a cycle of experimentation, expansion, saturation, and decline. When styles or fads are concerned the cycle may be relatively short. Versatile equipment may outlast the product, but specialized equipment is likely to decline in value as the demand for the product declines. The steady progress of technology may gradually improve the efficiency of competitive equipment or somebody may suddenly discover some very much cheaper way of accomplishing the purpose.

Value in the case of long-life assets may mean either (1) value in use or (2) value in exchange. In the first case the value will depend upon what the price of the product produced will be able to pay toward the cost of the equipment which produces it. In the second case it is the price at which the equipment itself can be sold second hand. This in turn will depend upon the value in use of the equipment to a possible buyer.

If there is no intention or probability that the long-life assets will be sold the second-hand value is of no great importance. Few concerns are liquidated until after their property values have been seriously impaired by long-continued losses. Unless some other concern can make more money by the use of the property than the present owner the value-in-use will be higher than the value-in-exchange and the better index of value for ordinary purposes.

The value-in-use of any individual asset will be somewhere between (1) the replacement cost of an equal productive capacity in whatever form it can best be replaced and (2) its second-hand market value. Also the algebraic sum of the values assigned to the individual assets, tangible and intangible (patents, goodwill, organization, etc.), must equal the value of the group of which they form a part. The collective value-in-use of any autonomous group of assets to which earnings can be allocated will be the discounted present value of such earnings during the weighted average of the remaining lifes of such assets.

The value-in-use of the business as a whole can thus best be estimated from the trend of earnings. Hence one should look to the profit and loss statements rather than to the balance sheet for an estimate of the aggregate value of the net tangible and intangible assets of any business.

Cost Reflects Money Expended

The cost of anything is what one gives up—usually money—in order to get it, whereas value depends upon an opinion of the future and may vary from day to day. Cost is a historical fact capable of proof if records have been kept. The function of accounting is to keep such records of cost so that profits can be measured.

The usual practice is to keep two separate accounts for each type of long-life asset, one to show the cost expended for assets on hand and another to show what portion of that cost has been absorbed by profit and loss. The first or asset account is charged with all additions, betterments, and replacements and credited with all discards and salvage upon discard. The second and offsetting account is then credited with that portion of the cost which is charged each year to the current operating cost as so-called depreciation.

The offsetting account is commonly called a reserve for depreciation. The word reserve has about as many meanings as the word account. It may be (1) an asset like a cash reserve in a bank, (2) a liability like a reserve for taxes, (3) an allocation of surplus, or (4) a deduction from an asset like the depreciation reserve.

A good plan would be to confine the use of the word "reserve" to an allocation of surplus and to show these long-life asset accounts on the balance sheet somewhat as follows:

Machinery

Cost of Machines on Hand	$100,000
Charged to Past Earnings	60,000
Chargeable Against Future Earnings	$ 40,000

If we eliminate interchanges with stockholders as internal transactions, we can say that every dollar spent by a business concern is a cost regardless of whether it is spent for a short-life or a

long-life asset. Likewise every dollar received is income. In the long run the profit and loss is the difference between cash expended and cash received. All that the accrual method of accounting does is to anticipate or postpone the entry of cash transactions to the profit and loss statement. The extent of such anticipations or postponements is evidenced by the balance shown on the balance sheet.

Cost and the Balance Sheet

Except when definitely drawn up to show liquidating values or replacement cost for a proposed reorganization, the balance sheet is primarily a statement of balances carried or brought forward. While it does show the value of cash on hand, cash receivable, and cash payable, that is merely because these are money or money obligations. In the case of merchandise and prepaid expense it shows merely the unabsorbed cost and that is normally all that it shows in the case of long-life assets.

There might be less misunderstanding as to what the balance sheet is supposed to show if it were arranged as illustrated below.

A Possible Rearrangement of the Balance Sheet

Costs Credited to Suppliers but not yet Debited against Earnings	*Costs Credited to Suppliers but not yet Paid (Payables)*
For next year's expense	For materials, etc.
For merchandise on hand	For payrolls
For long-life assets	For long-life assets
Revenues (Gross) Credited to Earnings but not yet Received	*Revenues (Net) Debited to Earnings but not yet Paid*
Accounts Receivable	Dividends Payable
Notes Receivable	
Capital Available but not Invested	*Capital Received for Investment*
Cash in Bank	From Sale of Stock
Cash on Hand	From Reinvested Earnings
	From Bank Loans

Cost or Market, Whichever Is Lower

Costs are properly chargeable against the revenues resulting from their expenditure. If such revenues are very definitely in the future, the costs should be carried forward on the balance sheet as charges against future revenues. If the revenues resulting

from the cost expenditure are insufficient to pay for such costs, then that part which they cannot pay for must be charged against the revenues from other sources. Hence, if future revenues are likely to be insufficient to pay for the unabsorbed asset cost, the amount carried forward should be reduced so that it will not exceed what such future revenues can pay.

In the case of merchandise purchased but not yet sold, the balance sheet commonly shows cost or market, whichever is the lower. Similarly, in the case of long-life assets the balance sheet might well show whichever is the smaller (1) that portion of the cost which is fairly chargeable against future revenues or (2) that portion of the cost which future revenues are likely to be able to pay.

When Value Is Below Cost

The shrinkage in value of any machine can as a rule be measured by (1) the decline in its use and (2) the difference between the total cost of the product (including depreciation, but not interest) when produced on such machine and when produced by the most efficient machine on the market.

If the use of the machine has declined, the percentage of its original cost chargeable to the future should be checked to see that it does not exceed the percentage of estimated future operating hours to estimated total operating hours.

Whenever a machine available to competitors can produce the product at a lower cost, the ability of the existing machine to earn its full depreciation instalment has been potentially impaired. Suppose, for example, the comparison is as follows:

Cost per unit of Product	*Existing Machine A*	*Existing Machine B*	*Existing Machine C*	*Most Efficient Machine D*
Current cost	4.70	5.00	5.40	4.20
Depreciation	.60	.50	.40	.80
Total Cost	5.30	5.50	5.80	5.00

If the product is competitive it should be expected to pay in its price only for $5 of cost. Machine A may then still have 30 cents toward its cost, but machines B and C can no longer earn any depreciation instalments. If machine C is operated, 40 cents of the current cost must be absorbed by profit and loss from use of obso-

lescent machinery. Yet unless this 40 cents will pay a fair profit on the investment in machine D, it is cheaper to continue to run C than to replace it with D. There would be no profit at all to warrant replacing machine B and there would be a loss of 30 cents per unit if machine A were replaced.

Disposal of Unabsorbed Cost

When an average depreciation rate is charged for all the machines in a group regardless of their individual lives, the machines which earn more than 100% of their costs will provide an excess to pay for the unabsorbed cost of machines which have earned less than 100%. If, however, no machine is allowed to earn more than 100% of its cost, some other provision must be made for the unabsorbed costs.

One method is to charge every machine with an obsolescence premium in addition to its depreciation instalment. The unabsorbed cost of discarded machines can then be charged to a general reserve built up from such premiums.

If no reserve has been provided the balance of the asset cost can be charged to profit and loss, if small and uniform in amount from year to year, or to surplus, if large and unusual.

Unless the purchase price of the new asset discounts the cost of removal or is reduced by the turn-in value of the old asset no part of the cost of the old asset or of its removal should be charged to the new asset. The new asset should not be burdened with a greater cost than would have to be paid by a competitor having no old machine to turn in. Carrying obsolete machinery on the books is as reprehensible as carrying obsolete merchandise. Losses already suffered do not form any part of the cost of future income.

Replacement Cost

Replacement Cost a Hypothetical Hybrid

So-called replacement cost is neither true cost nor value. Rather it is a hypothetical hybrid representing what the cost might have been had the purchase been delayed until the present. It varies with the way replacement is conceived and changes from day to day. Replacement in totality might cost less than if piece by piece as originally acquired. Existing capacity might be replaced with

a higher asset cost but a lower operating cost. Yet one should not be taken into account without the other.

Its Use for Fire Insurance

Replacement cost should be used in computing the amount of fire insurance required, but there is no advantage for this purpose in having it on the books. Also insurance companies will not pay the entire replacement cost, but only some fraction of it as is arrived at by compromise. In theory the numerator of this fraction is the estimated future life and the denominator the estimated total life. Some new capital may, therefore, be required to make an actual replacement after a fire.

Not Needed for Financial Planning

Prosperous concerns try to maintain capital out of income, but not necessarily out of that part of income which is called cost. If only $10,000 was spent for an old machine it will require only that amount to replace its cost. If $20,000 must be spent for its replacement an additional $10,000 must be saved out of profit.

Financial planning is very important, but basing annual depreciation charges on replacement cost is of little if any help. Accumulated instalments to date must also be changed whenever prices change. Funds required for replacement are measured by probable replacement cost at the end rather than at the middle of an asset's life. Prices quite often reverse their trend and few assets are replaced in kind. The current replacement cost of a given capacity may be no better guide than the past cost of the existing asset. Capital requirements include expansion as well as replacement and working capital as well as long-term capital.

Of Doubtful Use in Pricing

The argument for use of replacement cost in pricing is usually stronger when prices are rising than when they are falling. Expediency rather than theory is likely to govern. The replacement cost of raw material is likely to be an important influence on price because material is replaced currently and comprises a large part of the total cost. Long-life assets, however, are not replaced currently and depreciation is usually only a small part of the total cost.

If raw material prices go up many concerns will increase the

order cost and selling price before using up the stock purchased at a lower price. They will expect their competitors to do the same. Theoretically, there may be as much reason for marking up the annual charge for a machine which has gone up in price, but the difference is that competitors are not buying machines currently. Hence, the market price will not reflect any change in the price of the machine as such. If the general price level is rising and it is possible to increase the price of the product it is usually easier to increase the markup above cost than to try to refigure the depreciation.

On the other hand, when prices of material or machines go down after purchase, everybody wants to use up the old stock before reducing prices. The market price of the product may drop as soon as material prices go down, but it is not likely to be sensitive to any decrease in the price of the machine. If, however, the general price level is falling and prices must be reduced in the attempt to maintain volume, it is proper to disregard the whole of the depreciation charge together with all other costs which are not reduced when the volume of sales declines.

Can Divide but not Change Earnings

Substitution of replacement cost for actual cost cannot alter the fact that the real profit or loss in the long run is the difference between money actually spent and money actually received. It can, however, divide the profit into two parts (1) profit or loss due to buying in the past instead of the present and (2) what the profit or loss would have been if all purchases had been made in the present. The algebraic sum of (1) and (2) must in the long run equal the difference between dollars expended and dollars received, but the division might allocate the earnings differently between years and managements. One part could be called a capital loss and blamed on the past and the other part a current profit with a pat on the back for the present management.

Except in the case of March 1, 1913 value, replacement cost is of no use for income tax purposes.

Valuations for Balance Sheet

In the case of a reorganization which is practically equivalent to a sale and a fresh start, it may be worth while to have an inde-

pendent appraisal and to make a complete substitution of replacement cost for the book figures.

It is, however, very difficult to keep replacement cost up to date on the books and ordinarily it is neither worth while nor desirable to do so.

Whenever a decline in the price level is believed to be permanent, the future revenues might be expected to be less able than past revenues to pay for the cost of the long-life assets. In accordance with principles previously suggested it would then be wise to reduce the unabsorbed cost to what the future can fairly be expected to pay. The depreciation reserve should be credited and surplus charged with the difference. If such charge creates a deficit the stockholders' consent can be asked to a reduction in the par or stated value of the outstanding stock.

There is less excuse for recording an increase of the price level on the books. A footnote can usually give investors and others all the information they need in respect to replacement cost or values. If, however, the change is radical, as in the case of the German inflation, the substitution of replacement cost on a given date may be expedient.

Ordinarily any such increase in the asset valuation should be placed in an account separate from the original cost and the amount of the appreciation should be credited to a special surplus-from-appreciation account, which should be considered unavailable for dividends. Thereafter, the annual depreciation should be divided between (1) a writeoff of the original cost against profit and (2) a writeoff of the appreciation against the surplus from appreciation.

Charging the Product

Methods of Allocating the Cost

Methods of allocating the cost of long-life assets to the cost of the product produced during the different years of its life may for convenience be classified as follows:

(1) Straight-line depreciation to equalize costs,
(2) Curved-line depreciation to equalize profits,
(3) Charging average expenditures,
(4) Pay-as-you-buy,
(5) Pay-as-you-replace.

The selection of the method will depend somewhat upon circumstances and the point of view.

Straight Line—Equal Cost

Under the straight-line method the unabsorbed cost of the asset is reduced by a straight line from 100% at the beginning to zero or salvage value at the end of its life. This involves an equal charge per year, per operating hour, or per unit of product.

The life can be estimated in years and the depreciation charge figured as an equal amount per year. Or the life can be estimated in machine hours so that the amount charged per year will vary with the hours operated. If obsolescence or the action of the elements is the principal factor in limiting the life, the per annum basis is usually better. If mechanical wear and tear is the principal factor the operating hours may be better, provided the rate is adjusted when the speed is changed. If the speed varies with the job, revolutions or impressions may be fairer than hours.

The objection to the annual basis is that it increases costs per dollar of sales when prices have to be reduced to get business. While this is true of the business as a whole the individual job or product costs can be the same as under the hourly basis. The only real difference is that the overhead loss due to idle time bears its pro rata share of the depreciation under the per annum plan whereas under the per hour plan it is charged only with current expenses. Yet depeciation does not stop when machines are idle.

During a period of prolonged depression the replacement cost and future value of the assets suffer their greatest decline. While wear and tear may be reduced, invention and hence obsolescence are stimulated. A decline in sales usually has to continue several years before the management admits that it is other than temporary. During depressions and when sales are declining the per annum plan is, therefore, likely to prove more conservative.

Another plan divides the cost of the machine directly by the number of units of product or service expected during its lifetime.

Each unit of product is then required to contribute an equal amount toward paying for the machine. This plan has all the disadvantages of the per hour plan and if the machine time per unit of product varies it is less scientific. Also it is not feasible when a common denominator of quantity is lacking.

The arguments in favor of some form of the straight-line method are (1) its simplicity, (2) its acceptance for income tax purposes, and (3) the fact that it gives an equal cost per year, hour, or unit throughout its life.

Curved-Line—Equal Profits

Curved-line depreciation is advocated by accountants who believe that the ideal is not an equal cost per unit for 15 or 20 years, but rather a cost which will start relatively high and gradually decline the way all other costs are expected to do. Assets should not be bought unless they are capable of earning good fat initial contributions toward their costs. Each year brings new inventions. The longer a product is on the market the greater the competition. Therefore neither current costs nor depreciation instalments should remain constant over a long period of time. They must show a downward tendency, at least relative to the general price level, if a concern is to remain in business.

The tendency of repairs to increase as life advances is another argument in favor of greater depreciation during the early years. Some concerns build up a reserve to provide for such repairs as well as for the original cost of the machine. It is usually better to charge repairs to current expense as the money is spent but to lighten the charges for depreciation during the later years so that the repairs can be afforded.

The most common form of curved-line depreciation is figured as a percentage of the declining balance. Ten per cent a year, for example, would write off the following percentages of the original cost during successive years: 10, 9, 8.1, 7.3, 6.6, 5.9, 5.3, 4.8, 4.3, 3.9, 3.5, 3.1, 2.8, 2.5, 2.3, 2.1, 1.9, etc. This rate reduces the balance to 50% in 5½ years to 25% in 12 years and to 10% in 21 years. Other percentages of the declining balance would produce slightly different curves. If at the time of discard the residual balance is greater than the salvage, such balance must be charged off as in the case of obsolescence.

Other forms of progression are possible. For example: 15, 14, 13, 12, ... 4, 3, 2, 1, each figure being the numerator of a denominator equal to the sum of the numerators. In this case the numbers from 15 to 1 add to 120. Hence in this example 15/120 would be charged off the first year, 14/120 the second

and only 1/120 the last year. Any other series of numerators could be used in the same way. This plan like the straight-line plan carries the balance to zero if the asset lasts the estimated number of years.

The allocation of the cost of a long-life asset is a problem in joint costs. Instead, however, of such cost being joint as between different products in the same year it is joint as between the same product in different years. Usually the best allocation of a joint and scientifically indivisible cost is according to what the traffic will bear.

When a machine is bought, a concern can and should plan how it expects to get its money back. The cost of the machine can then be allocated according to this plan. The assignment of the same cost to every year may be no more sensible than charging suet and porterhouse steak with the same cost per pound of steer. A better way might be to allocate the cost so that the product will have the best chance of being sold at an equal profit per year throughout the life of the machine.

If, however, profit fails to come up to expectation the machine must be paid for just the same. Hence, the cost should be assigned on some predetermined basis and not varied after actual profit is ascertained. Any practice which permits the latter is likely to tempt postponement of writeoffs and encourage juggling. Also it will lack the disciplinarian effect of a systematic plan and fail to provide comparable costs.

Except in a new business which is not starting with a high profit, the curved-line depreciation probably reflects the probability of profit from the use of an asset better than the straight-line depreciation.

Charging Average Expenditures

Another way to figure depreciation is to base it on the average expenditure for a given class of long-life assets during a term of past years, said term to be equal to the average life of such assets. If assets last five years, for example, the straight-line depreciation would spread 20% of each year's purchases over each of the next five years. The depreciation for the fifth year would then consist of one-fifth of the amount expended during the preceding five years. This is merely another way of saying that when

assets last five years the proper depreciation for any year is the average of the purchases during the preceding five years.

The running average of purchases can be ascertained for assets of medium length life without knowing the life or taking an inventory. All expenditures for assets like tools and dies can be charged to departmental expense as made and the smoothed running average of the expenditures can be charged against the product. The difference between actual and average can then go into over-or under-absorbed overhead. This method may be useful in establishing departmental responsibility for medium-life assets. It does not work so well for assets of a longer life.

Pay-as-You-Buy

After a concern with a large number of assets units has been in business for some years, the unabsorbed asset cost tends to remain at about the same percentage of the original cost year after year. If the concern is neither expanding nor contracting, new assets coming in will about balance old assets passing out and on a straight-line depreciation basis the net will average about 50% of the gross. If the concern is expanding, the excess of assets coming in will raise the net to above 50%, whereas if assets wear out without being replaced the net will be below 50%. On a curved-line depreciation basis the net would average a much smaller percentage of the gross, perhaps around 30%, varying with the contour of the curve.

After an asset has reached a certain age, its second-hand resale value does not charge materially so long as it is in good operating condition. If assets are written down to this second-hand value as soon as they are purchased, then, if and when the business is liquidated, the assets will have a fair chance of selling for the amount at which they are carried on the books.

For one or the other or both of these reasons, some concerns write off from 50% to 90% of their assets at the time of purchase and the remainder when the assets are discarded. In case of a replacement, which is a matched purchase and discard, 100% would be charged to expense (except for price variations during the life of the discarded asset). If a business is expanding rapidly, the resulting writeoffs will be relatively high, but the profits probably will be able to afford them. If the business stops expanding, re-

placements only will be charged against profit. If it starts to decline, depreciation will continue but will not for some time impair the reduced book valuation.

A more extreme method followed by others is to write off 100% of the assets or all but a nominal amount at the time of purchase.

These methods have elements of financial strength and in some cases they may help to minimize taxation based directly or indirectly on property valuations. They have a stabilizing effect on the apparent or reported earnings because they understate profits when the business is expanding and overstate them at other times. Yet they fail to give a true picture of the trend of earnings or to furnish comparable costs. The stockholders, however, need not be misled if earnings are reported before as well as after depreciation. On the other hand, the same financial strength can be obtained without these disadvantages by building up surplus reserves.

Pay-as-You-Replace

Another theory is that the primary purpose of the depreciation charge is to provide for replacements. The arguments are (1) that a properly maintained property retains its full value until discarded and (2) that there is no need of building up a cash reserve in advance of the actual need for replacement.

If replacements average about the same amount from year to year they can be charged to expense as the money is spent. If they are less regular, the probable needs for replacements can be charted somewhat as the insurance actuaries chart the probable death rate for humans. Reserves can then be built up in accordance with the curve of probable need.

According to the law of human mortality, death is the result of two causes (1) chance, without any previous disposition to death, which is equal at all ages, and (2) deterioration or decline in the ability to withstand destruction as age advances. Arithmetical progression characterizes the first and geometrical progression the second. These same two causes operate in the case of long-life assets.

In humans the death rate is high in infancy. Machines which go through an experimental stage also start with a high rate of

mortality. Machines which are purchased fully developed may be likened to children adopted at age three. After infancy or the experimental stage is passed, the mortality or replacements per year tend to increase until the average age is reached and thereafter they tend to decline.

The survivor curve indicates the probability of survival among the assets of any particular class. The complementary curve indicates the probability of replacement. If the assets are written down to the survival curve and a reserve is built up to the extent of the mortality curve, then (if prices do not change) funds will probably be available to replace assets as they are discarded.

This theory stresses physical capacity and fails to recognize any decline in economic value. An old building may contain as much space as a new building, but it will not rent for as much. Trolley cars were capable of carrying as many people in their later years as when new, but fewer people rode in them. Industrial machines are supplanted by more modern ones or the products which they make can no longer be sold.

If a business is expanding the money charged for the use of old assets will be used to buy new equipment, to provide increased working capital, or to reduce indebtedness. If the business has no use for the cash its future may be limited. At least it will not continue to be worth what it was when new. When sales fall off replacements are not needed, but values are nevertheless on the road to extinction. If dividends are paid without providing for depreciation they will have been paid out of the stockholders' capital. While it is true that cash not needed in the business should be given to stockholders, yet such disbursements should not be labeled earned dividends unless the dollar capital invested in the business has been maintained intact.

Interest and Funds

Charging Interest to Cost

There are two methods of combining interest with depreciation. Under one, called the annuity method, the interest is charged on the unabsorbed part of the cost, i.e., the so-called residual value. Under the other it is charged on the amount absorbed, i.e., on the accumulated reserve.

The annuity method assumes that the buyer of a machine is purchasing an annuity which in a given time will return to him his original investment plus interest on the unpaid balance. This annuity is charged to cost each year for comparison with the actual revenues received from the use of the machine. Inasmuch as this method returns more than the original cost, the interest portion is normally credited to profit and loss as interest earned. Inasmuch as the interest is figured on the unpaid balance it is high during the early years and low during the latter years. If the combined charge is to be equal per year, the instalment of the principal must, therefore, be low at the beginning and high at the end. This postponement of the reduction of principal is one objection to the annuity method.

Contrariwise, the compound interest method assumes that the amount taken out of income is collected in a cash fund, which is theoretically earning compound interest until it has to be spent for replacement. Under this plan the machine itself pays no interest to the business and the accumulated interest may be used to relieve it of part of the cost of the principal sum invested. If the machine rather than the business is to be credited with the earnings of the reserve, it follows that the original investment of the business in the machine remains constant at the original cost. To complete the picture, the machine should be expected to pay the business a profit on the entire original cost during every year of its life.

Interest is the price paid for the use of well-cushioned dollar loans. The greater the proportion of dollar obligations to the cushion of owned capital the greater the risk to which the latter is exposed. Thus, while the interest rate may represent the cost of marginal capital for temporary needs, it can never reflect the average cost of the capital employed in a business. The latter can be measured better by the ratio of profits per share to the price per share which investors will pay for capital stock of the company or similar companies.

If real estate is purchased subject to a mortgage or if machinery is bought on the instalment plan the interest is a cost of the business. Ordinarily, however, long-life assets must be purchased with the owned capital rather than with borrowed capital. It would not be wise to purchase such assets except as their use promises a profit considerably in excess of the interest rate paid

on bank loans. Hence, the interest rate is of doubtful utility. It is usually easier and clearer to say that 12% profit is expected than to say that 6% profit in excess of 6% interest is expected.

If a standard profit or so-called interest is figured in the cost it should be figured on the entire investment, including short-life as well as long-life assets. It should be figured as simple interest on the average investment or on the actual investment of each year. Dividends are paid as simple rather than as compound interest. Compound interest should be used only for segregated cash funds actually earning such interest.

The amount charged to cost is usually credited to standard profit (or so-called interest) earned. Usually some adjustment of inventory valuation to eliminate the accrued profit is considered desirable. Some selling prices are apt to be less than and others more than the enlarged cost. The algebraic sum of the standard profit and these variations is the actual profit.

Instead of putting interest into the cost, it is generally better and easier to compare the actual percentage earned on the investmen with some standard or expected percentage. In other cases the difficulties of allocating investment independently of the cost records may make it easier to treat some standard or minimum percentage of profit as if it were part of the cost. The choice will be a matter not of theory but of expediency.

Sinking Funds vs. Financial Planning

The deduction of depreciation from profits tends to assure that an equal amount of cash will be withheld from dividends and, therefore, presumably left in the business. Such cash, however, is not set aside for replacements. It may and in most cases will be used for other business purposes. A fund goes one step beyond this and actually impounds the cash or invests it separately so that it will be available when required.

A fund is not to be confused with a depreciation reserve. It is a segregated sum of money or stock of convertible wealth, usually cash or marketable securities. A fund is thus an asset with a debit balance whereas a depreciation reserve is a credit balance used as an offset to the cost of another asset. Funds are commonly built up to pay off or "sink" a debt; hence, the term "sinking fund."

If the assets of a concern are composed of a relatively few large units it may be desirable for it to save up over a term of years for their replacement. If the business is not expanding it may have no profitable use for such savings. Under such conditions a sinking fund might prove advantageous.

Such a fund should be built so as to provide the cash when the replacements are expected. As this purpose would be quite different from that of a depreciation reserve, there would be no reason for the fund to agree in amount with the reserve.

A concern which is expanding can usually earn more by investing its savings in its own business. Also if replacements are made at about the same rate from year to year there is no need for building up a fund.

Every business, however, does need a long-range financial budget—a systematic method of estimating its capital requirements for as long a period ahead as may be necessary for the most efficient provision against such needs.

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